“A Study On the Role of Manual and Automation Testing in Software Quality Management with special reference to Pune city”

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1.Introduction

In order to understand the role of software testing in quality assurance a systematic approach was formulated to study the topic. The methodology that would be most appropriate to collect the necessary information was decided and accordingly the tool was prepared. With the help of the tool the information was collected from the respondents that best suited the defined criteria. The information collected from various sources was organized appropriately so that the data could be analyzed and represented in meaningful manner. Use of statistical method was applied in analyzing the information. The details of the same are given in this chapter so as to highlight the role of Software Testing in Software Quality Assurance for developing good quality software through the present study.

Developing reasonably defect-free software within budget and time, which meets the requirements and/or expectations, and is maintainable, has become a necessity in today's competitive environment. Delivering defect free software therefore requires the use of appropriate Software Testing processes, methods, techniques and tools. Software enterprises have now come to realize that in order to expand globally and profitably, they must have good quality software and services. Software Quality has been defined by various experts. Pressman Roger (2005) [1] defines Software Quality as "Conformance to explicitly stated functional and performance requirements, explicitly documented development standards, and implicit characteristics that are expected of all professionally developed software" whereas Burnstein Ilene (2003) [2] mentions IEEE definition of Software Quality as 1. The degree to which a system, component, or process meets specified requirements. 2. The degree to which a system, component, or process meets customer or user needs or expectations [IEEE Std. 610-12-1990]

In order to improve the quality of Software; Software Testing is the most important tool. Quality is the most important need for the user of a product and thus it is the foremost responsibility of the producer to understand and provide high quality software. Godbole Nina S (2004) [3] stated that, “It is essential that quality must be planned into the software development, evaluated continuously and the required corrections should be applied whenever required”. But how can this be achieved? It can simply be achieved by incorporating the right methods and techniques of Software Testing for verifying the correctness of the software and identifying the defects in the

software right from the start. If the defects are not identified in time it may impact cost and time required for software development. Therefore, Software defects are a major concern for every software development enterprise as every defect has cost and time associated with it. Defects in software can severely disrupt business operations as it would impact the quality of the software in a negative way resulting into customer complaints leading to customer dissatisfaction, loss of business and profits.

Thus, Software Testing plays a key role to avoid business damage resulting from software defects.

2.Statement of Problem

With the increasing demand for quality software from the customers, there is competition amongst the software enterprises to deliver good quality software. Customer satisfaction and quality software are the essential factors for the sustained growth and profitability of software enterprises. But with the growing business complexity and upcoming new technologies, developing software which provides all the required functionality and which is free from defects is a challenging task for the software enterprises. It is thus essential to implement proper quality assurance processes, software testing processes and techniques which will enable to achieve the goal of developing quality software. Lack of implementing these systematic processes would result in developing inferior software.

While making research over the topic, the following issues with respect to software failures due to the defect in the software emerged.

- Due to failure of the software because of defects, software enterprises had to spend high cost on defect rectification.
- Failures caused by software defects have also resulted into huge liabilities for the software enterprises with legal implications.
- Failure of software has implication on operations as the software fails to perform the desired functionality.
- The defect rectification cost is also very high depending on the severity of the defect, due to rework and this involves software man-hour costs.

These issues were useful in developing the present research work as it is observed that a majority of software failures are a result of insufficient process of software testing.

3.Importance of the Study

Helps in Cutting Costs

Software testing can help in saving money. If a bug is detected in the early phases of a project, it can be fixed at a lower cost. Furthermore, experienced and skilled testers can be hired to undertake software testing in-house, which can help a business owner save money that would otherwise be spent on a hired agency.

Security

With more and more persons joining the web and relying on online applications for their daily purchases, there is a huge reservoir of databases that exist on the Internet today. Any business must safeguard the data of its customers and clients. Software testing helps developers plug holes that could impact the security of their customers. With hackers and cyber-criminals trying to pry into systems to steal data, software testers can identify potential weak links and internally strengthen the system to prevent such attacks.

Quality of the Product

Every software application is designed to serve a specific purpose. The only way to check if the product is catering to the requirements of the business is to undertake software testing. Software testers can identify challenges and work on the software to make it function better.

Furthermore, software testers also check the compatibility of the program with devices and operating systems. This makes software testing an unavoidable step to ensure the high-performance of a software program.

Ensuring Customer Satisfaction

With online businesses thriving in the pandemic period, it has become a necessity to have a website or application that offers seamless navigation to its uses. Software testing plays an important role in ensuring customer satisfaction.

Expedite the Software Development Process

Software testers can fix bugs and issues in real-time with the Quality Assurance tool. This tool offers a wide range of scenarios and errors which allow a developer and tester to fix the problem

quickly. Furthermore, when developers and testers work in tandem, software programs and components can be quickly checked and fixed, which in turn can speed up the development process.

With the aid of **software testing**, you will be capable of verifying each and every aspect of software testing.

For instance, with the aid of **software testing**, it is possible to monitor whether the software is compatible with your browser.
Thus, in case, you gain success in finding any error, you will be having the option for the rectification of the same.
Thus, you will be capable of saving from the complaints and you will gain a high prominence slowly but gradually.

4.Objectives of the study

1. To identify and document the testing processes & systems at each stage of product development leading to quality assurance in software Organizations.
2. To identify the constraints and difficulties faced during software testing.
3. To study the procedure for rectification of defects practiced by software enterprises and its relation with time and cost.
4. To identify the requirements for implementation of Quality Assurance as an enabler for improved performance.

The following hypotheses have been formulated for the study, based on the above objectives.

5.Hypotheses

1. Quality Assurance plays a vital role in successful implementation of Software.

2. The choice of components of testing process depends on the knowledge of the software test engineers and software quality assurance managers of the software Organizations.

3. Software Quality Management/Assurance is a major factor responsible for contributing to profitability in software Organizations

After completion of literature review the process for formulation of the Research problem and then the formulation of the hypothesis will initiate. The following four hypotheses will formulate to test the objective of the study. Following is the list of hypothesis:

1. Hypothesis I - Quality Management/Assurance plays vital role in successful implementation of Software product. The above hypothesis will statistically state as:

   Ho: There is no association between standard processes and methods and quality assurance processes for successful implementation of software product. Alternative hypothesis
   H1: There is an association between standard processes and methods and quality assurance processes for successful implementation of software product.

2. Hypothesis II - The choice of components of test process depends on the knowledge of the Software test engineers and software quality assurance managers of the software enterprises. The above hypothesis will statistically state as:

   Ho: There is no association between the choice of components of testing process and the knowledge of Software test engineers and software quality assurance managers of the software enterprises. Alternative hypothesis

   H1: There is an association between the choice of components of testing process and the knowledge of Software test engineers and software quality assurance managers of the software enterprises.

3. Hypothesis III - Software Quality Assurance is a major factor responsible for contributing to profitability in software enterprises. The above hypothesis will statistically state as:

   Ho: There is no association between testing process for achieving quality assurance and profitability. Alternative hypothesis

   H1: There is an association between testing process for achieving quality assurance and profitability

6.Limitations of the study

It was proposed to study how software Testing helps in Software Quality Assurance in Software Organizations. An in-depth study will conduct in software enterprises located in Pune.

The study will limit to gathering the data from software enterprises in Pune as Pune is known as an IT hub and has large number top ranking IT enterprises. Also the type of operations performed in these enterprises remains same worldwide.

For testing the hypothesis and to study the research objectives several options will consider for the research and collection and analysis of data.

The study is limited to only about testing of Software Not overall developing of software

To opt for questionnaire survey of respondents due to the covert nature of operations in the IT sector.

The industry is not open to share sizeable qualitative and quantitative information due to the 'Non-Disclosure Agreements' (NDC) with the clients at various stages of the project. NDC's also exist in the organizations where the IT professionals are currently working which would also have to be honored. This makes it difficult to go in for a quantitative analysis which would have been possible in other sectors

7.Review of Literature

Kan. Stephen H. (2004) and Tian Jeff (2005) [1][2] mentioned the historical perspective about the evolution of software engineering and the increasing importance of software quality over a period of time which states that, the 1960's was the functional stage where Information technology was exploited to meet the functional needs of the organizations, 1970s the schedule stage era where organizations faced schedule delays and cost overruns, 1980s the cost stage where due to reduction in the cost of software, information technology became widely implemented in organizations and was available to individual users. There was a rapid increase in productivity of software development and increase in competition, the 1990s was the reliability stage which could be viewed as the beginning of quality era, able to provide abundant functionality; customers demand for quality further intensified by ever increasing dependencies on software.

Thus we can state the current era as quality stage era where, Software testing and Software Quality Assurance became predominant and 'quality' has become the most important criterion for the success and growth of the enterprises. Without them, software development projects are headed for failures; therefore, developing defect-free software has become a challenging task for software enterprises. The residue of even a minor defect may lead to failure of the software leading to heavy loss of business and also put a negative impact on the quality of the software developed. From the developer's standpoint quality is no longer an advantage factor but it has become a necessity to compete successfully.

Thus the software development has to be more efficient and the quality level of the delivered software has to be high quality to meet the customer's requirements and to be successful.

Quality Terminology

In order to achieve good quality software, application of systematic and disciplined approach towards software development is essential. The term quality describes the principles, concepts and approaches used for improving the quality of the product. The meaning of quality has emerged over a period of time. Each of the definitions individually has its own merits and presents a viewpoint on quality. Kan. Stephen H. (2004) [1] stated that, "Quality must be defined and measured if improvement is to be achieved".

In this context, definition by Philip Crosby (1979) states quality as “conformance to requirements” [3]. Another definition given by to Dr. Joseph Juran and Gryna (1970) it is “fit for use” [1] [4]. The definition “Conformance to requirements” considers developers view which implies that the requirements must be stated clearly and there is no misunderstanding. “Fitness for use” definition considers customers’ requirements and expectations which indicates that the required functionality should be provided [4].

Thus it can be stated that “Quality is an utmost important requirement for the sustained growth of any organization in the global competitive scenario and so does it hold true for Software Quality”.

Software Quality

Ilene Burnstein (2003) [5], quoted the definition given by the IEEE standard glossary of software engineering terminology which defines quality of software as:

(1) The degree to which a system, component, or process meets specified requirements.

(2) The degree to which a system, component, or process meets customer or user needs or expectations. [IEEE Std. 610-12-1990]

Pressman (1997) [6] stated Software quality as: “Conformance to explicitly stated functional and performance requirements, explicitly documented development standards, and implicit characteristics that are expected of all professionally developed software.”

Godbole Nina S (2004) [3] further mentioned that, “It is essential that Quality must be planned into the software development, evaluated continuously and the required corrections should be applied whenever required”. To this Pressman Roger (2005) [7] mentions that, Since, Quality is a multifaceted concept driven by customer requirement the level of quality may vary significantly for different organizations.”

In Software, the attributes of quality are examined based on the components of quality. Several models of software quality factors and their categorization have been suggested over years. Roger Pressman (2005) [7] has given the classical model of software quality suggested by McCall and his colleagues consisting of 11 factors. These are further grouped in three categories –product operation, product revision and product transition [4] [7].

8 Research Methodology

Introduction to the Study

In order to understand A Study On the Role of Manual and Automation Testing in Software Quality Management

a systematic approach was formulated to study the topic.

The methodology that would be most appropriate to collect the necessary information will decide and accordingly the tool will prepare. With the help of the tool the information will collect from the respondents that best suited the define criteria. The information collect from various sources will organize appropriately so that the data will be analyze and represent in meaningful manner. Use of statistical method will be applying in analyze the information. The details of the same will give in this thesis so as to highlight the A Study On the Role of Manual and Automation Software Testing in Software Quality Management with special reference to Pune city for developing good quality software through the present study.

8.1Data Collection:

The research will conduct using both Primary and Secondary data.

8.2Primary Data

For Primary data collection structure questionnaire as a tool to study the research objectives formulate for the study. The research questionnaire will design taking into consideration the relevant data required for testing the hypothesis. the survey will conduct based on the perceptions & discussions made with the software professionals. The research design therefore centered around a survey of experts from the software enterprises to assess their opinions related to the study objectives; for this purpose, a scale was constructed for the research questions

8.3Secondary Data

The secondary data will initially gather to understand the research already carried out in the study that has been undertaken. The secondary will be collect from the Published Literature such as book or journals and Related Research papers that have been published in conference, journals and well known websites and other related sources which could provide information in the area of study.

8.4 Sample Design

It will propose to study how software testing helps in Software Quality Assurance in Software enterprises. An in-depth study will conduct in software enterprises located in Pune. The study will limit to gathering the data from software enterprises in Pune. The research will have been conduct using both Primary and Secondary data. For this study the primary data will select from the list of IT companies' directory compiled by Maratha Chambers of Commerce and Industries and Agriculture (MCCIA). The directory has listed 1030 software enterprises consisting of IT, IT Education (ITEDU) and IT enabled services (ITES). The enterprises chosen for the study were either into service or application development or product development. Thus the total number of Software enterprises remaining was around 430 and other 30 software enterprises which were not in the list of MCCIA's IT directory but fitting criteria of the study were chose. Thus the universe for study consisted of 460 Software enterprises. It was decided to select 15% sample from the

above mentioned universe. Therefore 69 software enterprises will select for final survey of which the final sample remaining was 65 software enterprises, 4 responses were removed due to lack of information.

The survey data of 65 software enterprises will also divide into two categories which were found to be most appropriate for research. Following is the demarcation of the groups and the number of enterprises in each category.

Category	**Software Organizations Type In Pune city**	**No**
Category 1	Capability Maturity Model - Integration (CMMI) Certified	31
	Non (CMMI)	34
Category 2	Product base	24
	Service base	31
	Both - Product & Service Base	7

This demarcation will consider adequate by the researcher for purpose of this research, and also the sample size is adequate for the study.

The secondary data will initially gather to understand the research already carried out in the study that has been undertaken. The secondary data will collect from the Published Literature such as book or journals and related research papers that have been published in conference, journals and well known websites and other related sources which could provide information in the area of study

The software enterprises for the study were selected based on the following criteria:

a) Software Organizations having at least five years of existence
b) Software Organizations that are into service or product type of software development.
c) Software Professionals having five or more than five years of experience and working as Project leaders, Software Test Engineers, Software Quality Assurance Managers and Software Quality Analyst.

8.5 Tools and Techniques of Analysis

Qualitative Data collection methods

- Online forms
- In depth interviews
- Online communities
- Web survey chat
- Groups

Qualitative Data Analysis

- Face to face Interview
- Online
- Mail
- Phone

Tools of data Analysis

- Scrum
- Excel
- Tableau
- Power BI
- Fine report

After the scale will construct the experts were required to respond to the questions such as choice of testing methods with respect to cost and time for rectifying the defects, contribution of Software Quality Assurance to profitability of the software enterprises etc.

Statistical Test Method will be applicable on the data collection method

9.Chapter Scheme

I. Introduction: to the Study It gives the introduction of the Research topic. It emphasizes on the importance of software testing to enhance the quality of the software without which the software developed may not provide the desired functionality. This chapter further gives the justification for the necessity of Research on this topic and states the objective of research.

II. Research Methodology: It gives details of the Research methodology applied for the study. The objectives, hypothesis, scope and limitations of the study, sampling technique, questionnaire designing, collection of data, data analysis and the statistical tests will use for testing the hypothesis are given in this thesis.

III. Review of Literature: This chapter focuses on the literature survey which will take on the basis of published literature and electronic medium. This chapter highlights the details of the previous study which states the importance of software in future, researchers may look into the software development life cycle from the dimension of cost and quality optimization. Quality and failing to deliver this, results in cost and time overruns. It also states the importance of the application of quality assurance process so as to have a systematic approach towards software development which will help in the sustained growth of software enterprises.

IV. Role of Software Testing in Software Quality Management This chapter gives the details of how various testing contribute to software quality and how software testing helps enterprises to have consistent increase in profits. Failing to implement the systematic set of process will lead to loss in the business. This happens mainly due to defects in the software because with the age of the defects; it affects cost and time required for software development. It further states how software defect rectification process can help to minimize defects and help in developing the software within cost and time

V. Survey Findings & Hypothesis Testing It is a Summary of Research Findings by analyzing survey data and the statistical results of the hypothesis test. The primary data collection is present in different form of and the interpretations will give for the same. The hypothesis formulate will teste based on the information collected with the appropriate statistical test.

Bhushan Madhukarrao Sawant — Research Student

Dr.S.K.Khillare — Research Guide

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